Bulletin 205 June, 1929

UNIVERSITY OF FLORIDA
AGRICULTURAL EXPERIMENT STATION
Wilmon Newell, Director

THE JAPANESE PERSIMMON IN FLORIDA

By A. F. Camp and Harold Mowry

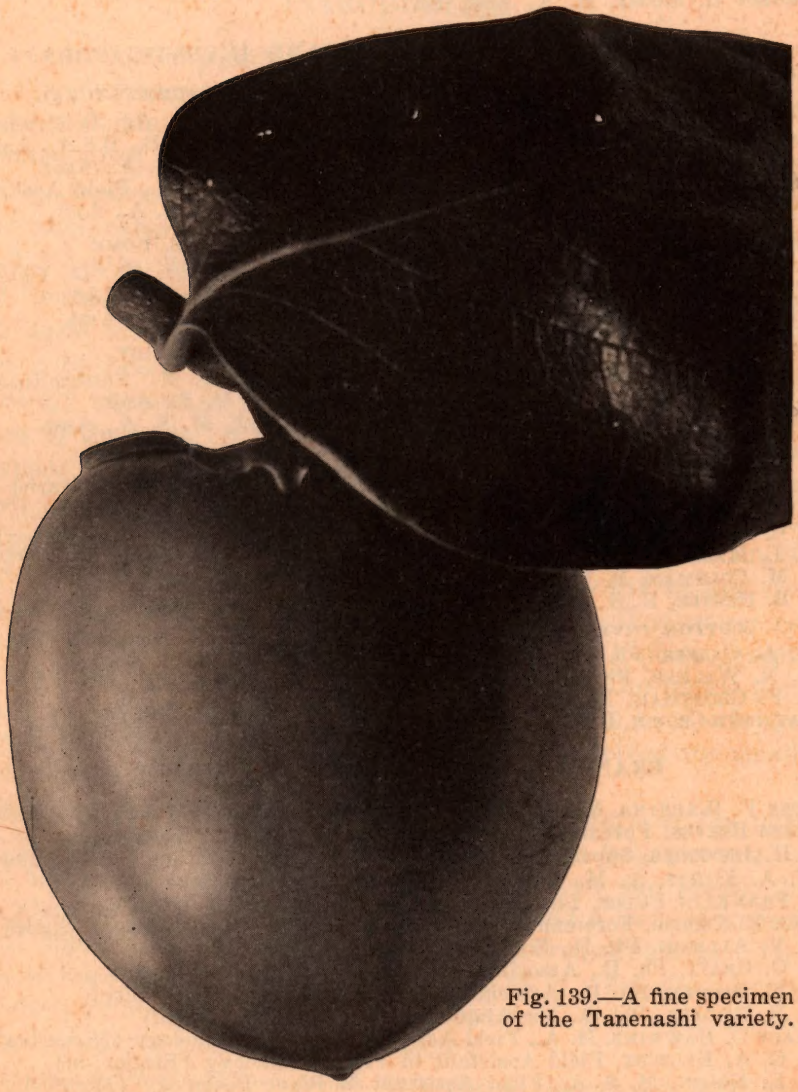

Fig. 139.—A fine specimen of the Tanenashi variety.

Bulletins will be sent free upon application to the
Agricultural Experiment Station
GAINESVILLE, FLORIDA

BOARD OF CONTROL

P. K. YONGE, *Chairman*, Pensacola
E. W. LANE, Jacksonville
A. H. BLANDING, Leesburg
W. B. DAVIS, Perry
FRANK J. WIDEMAN, W. Palm Beach
J. T. DIAMOND, *Secretary*, Tallahassee.
J. G. KELLUM, *Auditor*, Tallahassee

STATION EXECUTIVE STAFF

JOHN J. TIGERT, M.A.,LL.D., President
WILMON NEWELL, D. Sc., Director
S. T. FLEMING, A.B., Asst. Director
J. FRANCIS COOPER, M. S. A., Editor
ERNEST G. MOORE, M. S., Asst. Ed
IDA KEELING CRESAP, Librarian
RUBY NEWHALL, Secretary
K. H. GRAHAM, Business Manager
RACHEL MCQUARRIE, Accountant

MAIN STATION—DEPARTMENTS AND INVESTIGATORS

AGRONOMY

W. E. STOKES, M. S., Agronomist
W. A. LEUKEL, Ph. D., Asso.
C. R. ENLOW, M. S. A., Asst.*
FRED H. HULL, M. S. A., Asst.

ANIMAL HUSBANDRY

A. L. SHEALY, D.V.M., Veterinarian, in Charge
D. A. SANDERS, D.V.M., Asst. Vet.
E. F. THOMAS, D.V.M., Asst. Vet.
R. B. BECKER, Ph.D., Asso. in Dairy Husbandry
C. R. DAWSON, B. S. A., Asst. Dairy Investigations
W. N. NEAL, Ph. D., Asst. in Animal Nutrition

CHEMISTRY

R. W. RUPRECHT, Ph.D., Chemist
R. M. BARNETTE, Ph. D., Asso.
C. E. BELL, M. S., Asst.
H. L. MARSHALL, M. S., Asst.
J. M. COLEMAN, B. S., Asst.
J. B. HESTER, B. S., Asst.

COTTON INVESTIGATIONS

W. A. CARVER, Ph. D., Asst.
M. N. WALKER, Ph. D., Asst.
E. F. GROSSMAN, M. A., Asst.
RAYMOND CROWN, B.S.A., Field Asst.

ECONOMICS, AGRICULTURAL

C. V. NOBLE, Ph. D., Ag. Economist
BRUCE MCKINLEY, A.B., B.S.A., Asst.
M. A. BROOKER, M. S. A., Asst.
R. H. HOWARD, B.S.A., Field Asst.
JOHN L. WANN, B. S. A., Asst.

ECONOMICS, HOME

OUIDA DAVIS ABBOTT, Ph. D., Chief
L. W. GADDUM, Ph. D., Asst.
C. F. AHMANN, Ph. D., Asst.

ENTOMOLOGY

J. R. WATSON, A. M., Entomologist
A. N. TISSOT, M. S., Asst.
H. E. BRATLEY, M. S. A., Asst.

HORTICULTURE

A. F. CAMP, Ph. D., Horticulturist
M. R. ENSIGN, M. S., Asst.
HAROLD MOWRY, B. S. A., Asst.
G. H. BLACKMON, M. S. A., Pecan Culturist

PLANT PATHOLOGY

W. B. TISDALE, Ph. D., Plant Path.
G. F. WEBER, Ph. D., Asso.
A. H. EDDINS, Ph. D., Asst.
K. W. LOUCKS, B. S., Asst.
ERDMAN WEST, B. S., Mycologist

BRANCH STATION AND FIELD WORKERS

ROSS F. WADKINS, M. S., Lab. Asst. in Plant Pathology (Quincy)
JESSE REEVES, Foreman, Tobacco Experiment Station (Quincy)
J. H. JEFFERIES, Superintendent, Citrus Experiment Station (Lake Alfred)
W. A. KUNTZ, A. M., Assistant Plant Pathologist (Lake Alfred)
J. FRANKLIN FUDGE, Ph. D., Assistant Chemist (Lake Alfred)
GEO. E. TEDDER, Foreman, Everglades Experiment Station (Belle Glade)
R. V. ALLISON, Ph. D., Soils Specialist (Belle Glade)
L. O. GRATZ, Ph. D., Associate Plant Pathologist (Hastings)
A. N. BROOKS, Ph. D., Associate Plant Pathologist (Plant City)
A. S. RHOADS, Ph. D., Associate Plant Pathologist (Cocoa)
STACY O. HAWKINS, M. A., Field Assistant in Plant Pathology (Homestead)
D. G. A. KELBERT, Field Assistant in Plant Pathology (Bradenton)
R. E. NOLEN, M. S. A., Field Assistant in Plant Pathology (Monticello)
FRED W. WALKER, Assistant Entomologist (Monticello)

---

*In cooperation with U. S. Department of Agriculture.

THE JAPANESE PERSIMMON IN FLORIDA

By A. F. Camp and Harold Mowry

Note: The manuscript for this bulletin was written prior to April 6, 1929, when the Mediterranean fruit fly was discovered in Florida. The Japanese persimmon is a host of the fruit fly, and readers of the bulletin should bear this in mind.—Editor.

INTRODUCTION

The Japanese[1] persimmon *(Diospyros kaki* L.) has been grown in Florida for over fifty years. Although the fruit has not become a staple commercial product, the acreage has slowly increased until at the present time there are approximately 850 acres, comprising a total of about 88,000 trees of both bearing and non-bearing ages. The production for the year 1927 was 13,475 crates, having a valuation of $42,380.[2]

Climatic and soil conditions obtaining in Florida evidently are quite favorable to the growth of the tree, as bearing trees are to be found in nearly every county of the state, though apparently somewhat better adapted to the more northern portions of the state. A lack of concentration of plantings and the absence of any organization for handling and advertising the fruit has been largely responsible for unsatisfactory returns to shippers. Sporadic shipments to northern markets with no effort made to maintain a steady supply or demand in any one market have and will continue to bring widely fluctuating returns. Considering that there are no standard Florida brands or varieties well known to the market and that the public generally is unacquainted with this fruit, it cannot be fairly expected that fancy prices will consistently be received for small, irregular shipments.

Most of the difficulties encountered by growers in the past can be attributed to a few causes that deal with both production and marketing. Production troubles have been due mainly to the planting of a multiplicity of varieties and a lack of knowledge concerning the peculiar pollination requirements. The lack of knowledge on the part of buyers as to what should constitute a prime fruit, and a lack of organization in selling have been the major obstacles in marketing.

Growers have planted small acreages of numerous varieties,

[1]Also commonly termed Kaki or Oriental persimmon.
[2]Nineteenth Crop Census, Florida State Department of Agriculture.

some of which, due mainly to size or flesh color, were entirely unsuited to marketing purposes. In many plantings the trees have failed to mature fruit satisfactorily, due either to a light set of fruit in the first place or to a heavy dropping of immature fruit following setting. In other cases some supposedly light-fleshed varieties have ripened as dark or mixed-fleshed fruits unsuitable to the market. These troubles arose mainly from a failure to provide for proper pollination and it was not until 1914 that exhaustive studies by Hume determined the cause and outlined a basis for scientific planting.

Plantings generally have been small and as a consequence fruit has seldom been produced in quantity sufficient to provide for large or regular shipments. This situation has not permitted an organization of the growers which would provide for proper marketing and advertising. The consuming public, not being familiar with the Japanese persimmon and after attempting to eat the fruit while immature and yet highly astringent, has been deterred from further purchases by the highly undesirable puckery effect resulting. This ignorance of the desirable quality of ripe fruit might be easily overcome by educational advertising.

Larger acreages, within limited areas, would result in a steadier supply to the market, a more uniform pack and grade, and an opportunity for effective advertising at small cost to the individual producer. When these conditions are fulfilled the character of the fruit is such that a satisfactory demand should follow naturally. In the meantime a few growers, putting up a uniform pack and grade and catering to special markets will find this fruit a profitable crop.

HISTORY

There is but one widely distributed American species of the persimmon (*Diospyros virginiana* L.), this species being a native of the central and southern portion of the eastern United States. The fruit of this species is small and seedy and very "puckery" until fully ripe. It has been used as food by both the Indians and whites but has never come into the high favor in this country that the Japanese persimmon has enjoyed in Asia.

The Japanese persimmon has been known in China and Japan for many centuries and is regarded there as a staple fruit, American observers considering its role in those countries to

be on a par with that of the apple in this country. The first introduction of the Japanese persimmon into this country came as a direct result of Commodore M. C. Perry's visit to Japan in 1856. Seed sent back by his expedition were planted at the Naval Observatory in Washington, but the seedling trees were subsequently frozen out before any had been distributed. Later importations of seed, including some brought back by Saunders, in 1863, experienced a similar fate.

In 1870 the Department of Agriculture imported a number of grafted trees and some of these, together with many trees imported by individuals during the next few years, were sent to the Southern states where they were found to grow well in many localities. Following the successful growth of these early introductions many individuals imported trees in considerable numbers until all such importations were stopped by the Federal quarantine in 1919.

Very little information is available concerning the early spread of this fruit in the south. Two nurserymen, P. J. Berckmans, of Augusta, Georgia, and G. L. Taber, of Glen St. Mary, Florida, did a great deal to advance the early spread of this fruit and carried on careful studies of varieties and the cultural requirements of the trees. It remained, however, for H. Harold Hume to straighten out the difficulties which had been encountered in pollination and to put the variety situation upon a sound basis and his work may be said to be of preeminent importance to the persimmon industry in this country.

The varietal names in use in America represent an approximation of the Asiatic names by which the original importation was designated or purely American names applied to selected seedlings propagated in this country. In no case do our varietal names correspond, as far as we know, to any widely distributed clonal varieties[3] of similar name in the orient. The varietal names there apparently are more or less localized and probably apply to types rather than being restricted to clonal varieties. This is the natural result of the lack of widespread communication in the Asiatic countries. In addition to the above difficulties in designating varieties, the ignorance of the Japanese and Chinese languages in this country led to peculiar adaptations of the names supposed to be attached to importations, so that

[3]A clonal variety is a variety originating from a single bud or scion and continuously propagated vegetatively, i.e. by budding, grafting, or cutting.

the name applied in this country may actually not resemble very closely any oriental terminology. There are now in this country a large number of varieties, with Asiatic or pseudo-Asiatic names, as well as some with truly American names, whose characteristics are well defined and whose standing as well established varieties in this country is above criticism.

CHARACTER AND VALUE OF THE FRUIT OF *DIOSPYROS KAKI*

The persimmon is probably the best known staple fruit in China and Japan, and the genus furnishes wood and a dye in addition to the edible fruit. The generic name *Diospyros* literally means "food of the gods" and indicates the esteem in which the fruit is held in those countries where it is well known. The flavor of the fruit is excellent and compares favorably with any of the fruits known in this country. Its food value is very high and analyses show an average sugar content higher than that of many of the common fruits such as peaches, apricots, oranges, etc. The following figures compiled from various sources are typical of many analyses of the common fruits:

Fruit	Percentage of total sugar in whole fruit
Apples	9 to 10
Cherries	10 to 11
Strawberries	5 to 6
Oranges	4 to 9
Grapefruit	5 to 8
Japanese Persimmons	14 to 18

It should be noted that the amount of sugar exceeds that found in most of the common fruits and that all of the sugar is in the form of dextrose (glucose), this having a particular bearing upon its dietary value.

Most of the varieties of Japanese persimmons, as well as the native persimmons, are astringent (puckery) until fully ripe, although some, particularly the dark-fleshed oriental varieties, do not have this quality. This astringency is due to the presence of soluble tannin compounds in the flesh of the fruit. This astringent characteristic does not disappear in most varieties until the fruit is fully ripe and it is thought that at that stage the tannin is combined with some colloidal carrier, with which it is associated, to form insoluble tannin bodies which do

not have an astringent effect.[4] In the case of some of the non-astringent varieties the tannin usually undergoes an oxidation before ripening with a resulting loss of astringency so that the fruits may be eaten while still hard. This lack of astringency is associated usually with the dark-fleshed types, though the Fuyu and some others remain non-astringent and light fleshed, even when pollinated.

The astringency can be eliminated by the use of various artificial methods of ripening. In the Orient, persimmons are commonly processed by one of various methods and go onto the market non-astringent though still more or less firm. The fruits while still hard are frequently packed in freshly emptied saké (rice-beer) tubs and covered over so that the fumes from the alcohol left in the walls of the tub can act upon them. This method of ripening requires from 10 to 15 days and when properly done the fruit will still be fairly hard at the end of that period, though completely non-astringent. Experiments in this country showed that similar results could be obtained by packing the persimmons in barrels, the walls of which had been moistened with alcohol just before the packing. Under these conditions the astringency disappeared entirely and the fruit was of a very excellent flavor, but not in first class condition for long distance shipment.

The hard persimmons are also subjected to the fumes of an incense burner in a closed space. The fruit is placed in a large stone jar with a perforated bamboo cylinder in the center in which a stick of incense is allowed to burn. The fruits when ripened by this method are usually quite soft and have to be consumed within a very short time.[5] The active principle in this method appears to be carbon dioxide. Fruits treated with this gas, in experiments in this country, ripened very rapidly with a consequent loss of astringency.

According to still another method, fruits are soaked in lime water made up of 1 part of lime to 10 parts of water. The time required varies from two to ten days, depending upon the variety and the state of maturity of the fruit. Fruits when treated by this process are firm but juicy and entirely non-astringent. They are covered with a white bloom of lime which is very care-

[4]Lloyd, Francis E. The behavior of tanin in persimmons. Plant World 14:1-14, 1911.

[5]McClure, F. A. Notes on persimmons in Kwangtung. Lingnaam Agr. Review 3:2 91-98, pls. 10.

fully kept intact when persimmons are handled in this manner in the Orient. According to McClure, persimmons ripened by this method are classed in China as hard persimmons, while those ripened by the smothering method are called soft persimmons. It is doubtful, however, if fruit ripened by the lime-water method would carry as well as untreated fruit, so that the use of such a method would be indicated at the marketing rather than the growing end.

Recent experiments by Overholser[6] and others have indicated that ethylene and other gases also will remove the astringency and it is quite possible that methods could be worked out for treating fruit on a commercial scale by the use of this or other methods. Up to the present time, however, fruits have not been placed upon the market after treatment by any of these methods, so that it is not known whether the persimmon could be popularized in this country by that method. The general tendency has been to search for varieties, such as the Fuyu, which are not astringent when hard and to extend the plantings of these in preference to the astringent varieties.

The fruits are also dried in the Orient, this being accomplished by cutting the fruits from the tree with a small "T" shaped piece of the twig attached to them. These fruits are then peeled, attached together in strings, hung up in direct sunlight and allowed to dry. Varieties with firm flesh, such as the Tanenashi, are favored for this purpose. Experiments by the United States Department of Agriculture[7] have shown that they can be dried readily at 122°F. in the standard evaporator and that the darkening of the flesh during this process can be prevented by steaming the fruit before drying. Thus far the dried fruit has not been marketed in this country. When fruit is dried for home consumption it should be peeled with a nickeled or stainless steel knife to avoid staining the flesh.

BOTANY

The persimmon belongs to a family of plants that is very widely distributed in the tropics but with a relatively small number of species in the temperate countries. This family, the

[6]Overholser, E. L. Some studies upon ripening and removal of astringency in Japanese persimmons. Proc. Am. Soc. Hort. Sci. 1927:256-266.

[7]Gore, H. C. Large scale experiments on the processing of Japanese persimmons. U.S.D.A. Bur. Chem. Bul. 155:1-20. 1912.
Meyer, F. N. U.S.D.A. Yearbook 1915:212-214.

Ebenaceae, includes the ebony of commerce and other tropical plants of commercial value for wood and dyes. The persimmon belongs to the genus *Diospyros* which includes some 200 species, most of which are tropical or subtropical in requirements.

D. virginiana L., the common American persimmon, grows wild in a wide belt across the southern United States. The fruit of this species is used for food, though it is of small commercial value. Other species occurring in this country and Mexico are of little importance. In the Orient the so-called "Japanese persimmon" *(Diospyros kaki* L. f.) is the most important species and the one in which we are particularly interested. While its common name would indicate Japanese origin, it is probably a native of China, its common name coming through the fact that it was first imported into this country from Japan. The use of the term "Oriental persimmon" might be considered more nearly correct. Another species, *D. lotus* L., is found in northern China, Japan and other parts of Asia. Its chief interest, from the American standpoint lies in its potential use as a rootstock for the cultivated forms of *D. kaki* in some of the areas in which this fruit is grown, since it gives promise of being superior to some of the rootstocks now in use.[8] Most of the remaining members of the genus are distinctly tropical.

The plants of the genus *Diospyros* are either deciduous or evergreen, and vary from shrubs to large trees. The leaves are alternate, entire, usually leathery and without stipules. The whitish flowers are borne in the leaf axils, the pistillate flowers usually solitary and the staminate in few to many flowered cymes. The calyx and corolla are mostly 4-lobed, the corolla being companulate or urceolate in shape. The stamens vary from 4 to 16, with 4 to 8 staminodia in the pistillate flowers. The ovary is 4 to 16 celled; fruit is a large, juicy berry with 0 to 10 seeds; the seeds are large, brown and flattened.

D. virginiana, the common American persimmon, varies from a shrubby tree with somewhat willowy growth to an upright tree 30 to 50 feet high. The foliage is glossy green, the leaves ovate or elliptic, 2 to 5 inches long and 1 to 3 inches wide. The trees are usually dioecious, i.e., the staminate flowers (pollen bearing flowers) are borne on separate trees from the pistillate flowers (fruit producing flowers). The staminate flowers,

[8]Some of the wild forms of Japanese persimmons *(D. kaki* var. *silvestris* Mak.) are used in the Orient as rootstocks for the cultivated varieties of the same species.

borne in groups of threes, are four lobed, urn shaped, and of a white or greenish-white color. The pistillate flowers, solitary in the leaf axils, are ¼ to ¾ inches in length and closely resemble the staminate flowers in shape and color. The fruit, 1 to 2 inches in diameter, is subglobose to oblate (flattened at the base and apex) with many flat seeds (8 to 10) and with a comparatively small amount of flesh. The flesh is yellow to red in

Fig. 140.—Young tree of the Tanenashi variety. Note the type of growth.

color when ripe and varies from a granular or pasty to a custard-like texture. When green the fruit is very astringent; it must be fully ripe before it is edible.

The species is distributed from Connecticut to Florida and eastward to Kansas, Oklahoma, and Texas. A number of selected seedlings have been named and described by nursery-

men, these including such varieties as the Ford, Early Golden, Glidewell, Hicks, Josephine and others. None of these varieties is grown commercially in Florida at the present time, the value of the species in this area lying in its use as a rootstock for *D. kaki.*

D. kaki is a tree growing up to 40 feet in height, but not attaining this height in Florida, usually with a roundish crown, but varying from a willowy to an upright habit of growth, frequently of an irregular shape due to the breaking of limbs from overbearing. The leaves are obovate to elliptic-ovate, but very variable in the different varieties, glossy green above and with

Fig. 141.—Flowers of the Japanese persimmon. The small flower at the left is staminate (male) and the remaining flowers are pistillate (female).

a slight pubescence on the under surface. Three kinds of flowers are borne: perfect flowers having both stamens and pistil, pistillate flowers having a pistil and no stamens, and staminate flowers having stamens but no pistil. The fact that one or more of these types of flowers may be borne on any one tree led to considerable difficulty in the early classification of Japanese persimmons. Later Hume[9] worked out the flowering characteristics

[9]Hume, H. Harold, Planting persimmons. Jour. of Heredity 5:131-138, 1914. Also Hume, H. Harold, Non fruiting of Japanese persimmons due to lack Pollen, Science U. S. 30:308-309, 1909.

very carefully and showed that there were three groups of varieties. In one group only pistillate flowers are borne and varieties of this type are characterized as pistillate constants. In a second group both pistillate and staminate flowers are borne regularly and these varieties are designated as staminate constants. In a third group pistillate flowers are borne and occasionally staminate flowers, and this group is characterized as staminate sporadics.

The first group, pistillate constants, includes most of our common commercial varieties, such as Tanenashi, Hachiya and Tamopan. Some varieties in this group commonly have no seeds in the fruit and bear fruit without pollination. In other varieties the fruits are usually seedy and pollination is necessary for the setting of fruit. With these last varieties it is necessary to interplant trees from the group of staminate constants, the variety Gailey being commonly used because of the profusion of staminate flowers borne by it. The native persimmon will not cross with the Japanese persimmon and consequuently cannot be used as a source of pollen for plantings of the latter.

In California the pollination problem is apparently less important than it is in Florida. This may come about partially through the fact that the Hachiya, which will bear fruit without pollination, is the principal commercial variety, and that two other varieties that are grown to some extent, the Tanenashi and Tamopan, fall in the same group.

VARIETIES

Attempts to classify varieties according to fruit characteristics proved unsatisfactory until Hume[10] completed his pollination experiments which showed the differences that might exist between fruits resulting from pollinated and unpollinated flowers. It had been noted that some varieties had light fleshed fruit while others had fruit with a dark flesh, while still other varieties appeared to show an intermediate condition, having a flesh that was part dark and part light. To make the matter still more complicated a tree might bear fruits which were either

[10]Hume, H. H. A *kaki* classification. Jour. Heredity 5:400-406, figs. 6-11, 1914.

totally light or totally dark fleshed while still other fruits on the same tree would show only partial darkening.

Hume's work in clearing up this situation showed that the persimmon varieties could be classed into two groups. In the first group the fruit was light fleshed whether it bore seeds or not and these varieties he called pollination constants.[11] The second group was found to be made up of varieties which had a fruit that was light fleshed when seedless (unpollinated) but dark fleshed when seedy (pollinated), and these varieties were called pollination variants since the color of the flesh depended upon whether or not the flower producing the fruit was pollinated. In some varieties in this group a fruit with only one seed in it will have a dark area around that seed, but the remaining flesh may be light; or, if there are only two seeds side by side, that side of the fruit will have dark flesh and the remainder of the flesh will be light; two seeds oppositely placed will usually color all the pulp. This led to the early clasification, which labeled these fruits "mixed fleshed" and it was not until after Hume's later work that it was noted that this darkening was variable and depended upon the number and location of the seeds.

In the following table the varieties that are grown in this state are classified under Hume's two groups, the important commercial varieties being in black type.

POLLINATION CONSTANTS Light-fleshed whether seedless or seedy	POLLINATION VARIANTS Light-fleshed when seedless, Dark-fleshed when seedy.
Costata	Gailey
Fuyu (gaki)	Godbey
Hachiya	Hyakume
Ormond	Okame
Tanenashi	Taber's 129
Tamopan	Taber's 23
Triumph	Yemon
Tsuru	Yeddo Ichi
	Zengi

It will be noted that the first group, the pollination constants, includes the common commercial varieties in both Florida and

[11]Some varieties of the Japanese persimmon will develop fruits that are normal as to size and shape when the bloom is not pollinated and these fruits are seedless. This sort of development is not uncommon in cultivated fruits, and a number of seedless fruits develop in this manner. In most fruits, however, pollination is necessary to fruit setting; and this is the case in some of the varieties of persimmons, though it is often possible to get an occasional unpollinated bloom to set and develop fruit. The Hachiya and Tanenashi apparently set fruit readily without pollination; and almost all of the fruit of these varieties going on the market is seedless, though an occasional seedy fruit is found.

California, i.e., the Tanenashi, Hachiya, Tamopan and Fuyu. Of these the first three are ordinarily seedless, though they may occasionally show one or more seeds, while the Fuyu is seedy. In the second group there are no varieties of present commercial importance, since the market so far has not been disposed to accept dark fleshed fruits freely. In this group, however, are the varieties which commonly bear large numbers of staminate flowers, and it is from this group that pollinators are picked for mixed plantings. For this purpose the Gailey variety has been found highly satisfactory and one or two other varieties have been recently proposed.

Dark fleshed fruits of some varieties are non-astringent when hard, although fruits of the same variety will be astringent when seedless and light fleshed. If the prejudice against the dark fleshed fruit could be overcome this non-astringent quality would prove highly desirable, since the buyer who is unfamiliar with persimmons and who purchases his first persimmons on the market and samples them before they are properly ripened quite frequently fails to buy again. It was thought for a long time that there were some non-astringent light fleshed varieties grown in China and Japan and an effort has been made to bring them into this country. It was found, however, that when these varieties were moved from one locality to another their characteristics might change. As for instance the Tamopan, which is said to be entirely non-astringent in many localities in China, is consistently astringent in Florida until fully ripe. At the present time the Fuyu appears to be the only light fleshed consistently non-astringent variety available in this country and for that reason it is being recommended as a market variety. Until it has been thoroughly proven, both in the field and on the market, however, it cannot be recommended, unqualifiedly, for the planting of large acreages.

Two varieties now monopolize commercial production, the Tanenashi in Florida, and the Hachiya in California. The Tanenashi is grown to a certain extent in California, but the Hachiya seemingly does not do well under Florida conditions, bearing very light crops. The Tamopan has been grown in both California and Florida and the fact that it is seedless and of a peculiar shape has made it popular with some growers. The quality of its fruit, in the opinion of many, does not approximate that of either the Hachiya or Tanenashi.

Both the Tanenashi and the Hachiya are ordinarily seedless, which is a highly desirable characteristic in marketing. The Hachiya has a custard like flesh while that of the Tanenashi is of a peculiarly pasty consistency which is a distinguishing char-

Fig. 142.—Fruit of the Costata variety (four-fifths natural size).

acteristic of the variety. The quality of the latter is excellent and it is particularly adapted to drying as well as eating as a dessert with sugar and cream. As far as Florida is concerned, the Tanenashi is a proven variety that has all the desirable market characteristics enumerated above and which is known to be prolific and to grow well throughout most of Florida. The Tamopan should have a limited market demand but its extremely juicy and soft flesh is not relished by all consumers. It has a peculiar shape, however, which will enable those who prefer it

to distinguish it from other persimmons. If the Fuyu continues to prove satisfactory in growth and quality it is quite likely that it will be a leading commercial variety in that it is non-astringent and edible while still hard. This variety is also being grown in California and is certain to have an extensive trial upon the market in the very near future.

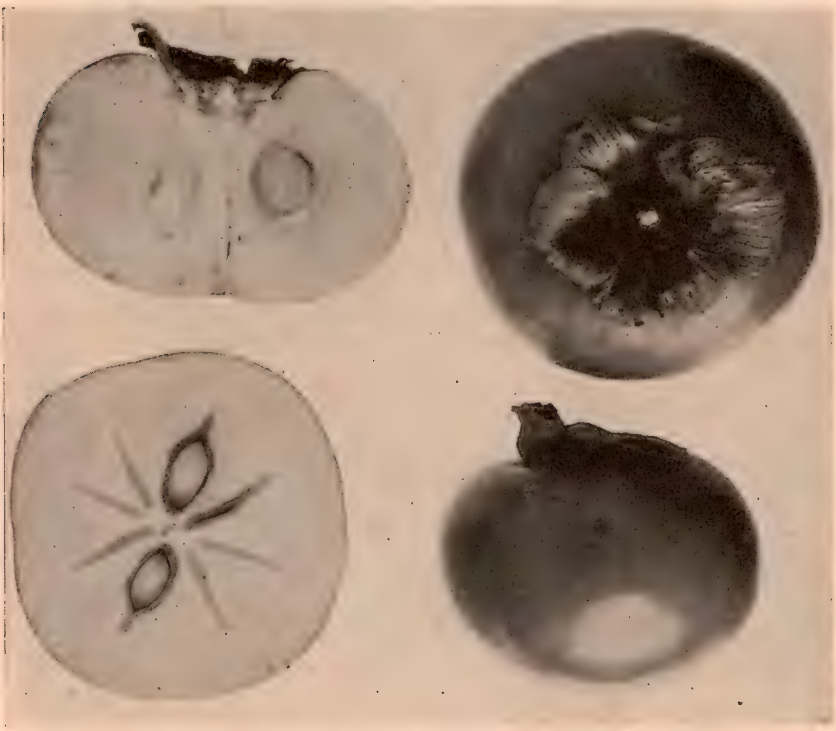

Fig. 143.—Fruit of the Fuyu (Fuyugaki) variety (two-thirds natural size).

For home planting the dark fleshed varieties stand on a par with the light fleshed varieties and some of them are non-astringent and of fairly good eating quality while still hard. Below is given a list of persimmon varieties in the order in which they ordinarily ripen so that those desiring a home planting may pick varieties calculated to give a continual supply of fruit over a long season. It should be noted in this connection that one tree of Gailey, or other heavy bearer of staminate flowers, should be interplanted to every eight trees of other varieties. For home plantings the following varieties will give a supply of ripening

fruit from August to October, the varieties ripening in approximately the order named.

Zengi
Okame
Triumph
Fuyu (gaki)
Tanenashi
Hyakume
Yemon
Costata
Tsuru
Tamopan
Ormond

Fig. 144.—Fruit of the Gailey variety (natural size).

Three general shapes of persimmons are recognized. The conical shape, which is represented by the Tanenashi and in which the fruits are longer than broad and tend to come to a

point at the apex; the roundish type, represented typically by Taber's No. 23, in which the fruit is fairly round and only slightly flattened at the apex, and the oblate type in which the fruit is tomato shaped or flattened, the Triumph and Fuyu being representatives.

Fig. 145.—Fruit of the Hachiya variety.

Below will be found brief descriptions of the various varieties grown in this state arranged alphabetically according to variety.

Costata—Fruit conical, pointed, size medium to large, 2¼ by 2½ inches. Skin reddish to deep red on ripening, with heavy bloom. Flesh firm, granular, whitish yellow, astringent until ripe, nearly seedless but occasionally with one or two long oval seeds. Ripens October.

Fuyu (Fuyugaki)—Fruit oblate and pronouncedly flattened, indistinctly quadrangular, size medium to large, usually about

3 inches across. Skin smooth, glossy, deep tomato-red in color. Flesh light orange, non-astringent even when hard so that it can be peeled and eaten like an apple before it softens; flesh firm when ripe and of good quality; ordinarily with few seed and probably requiring pollination for bearing in Florida.

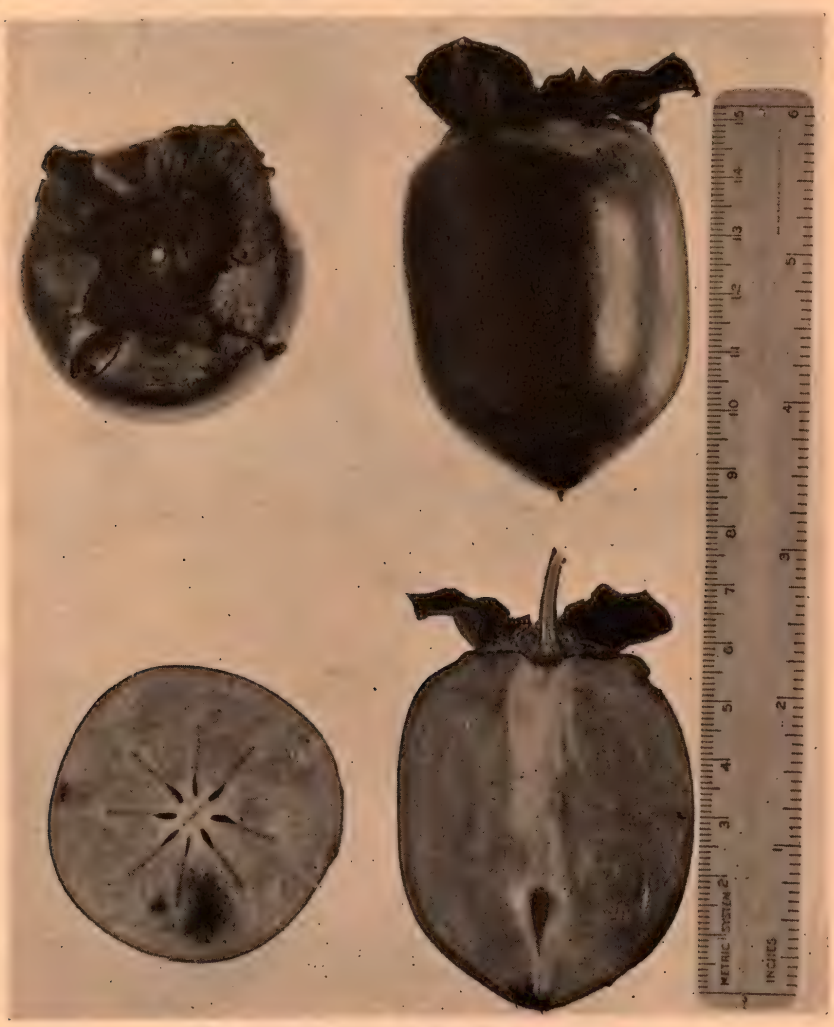

Fig. 146.—Fruit of the Nectar variety.

Introduced by the U. S. Department of Agriculture and distributed under S. P. I. numbers 26491, 32868 and 26773. There is some difference of opinion as to these importations being identical. The first two were introduced under the name Fuyu and the last as Fuyugaki. Probably the only one distributed in Flor-

ida to any extent is the one introduced as Fuyugaki under S.P.I. No. 26773.

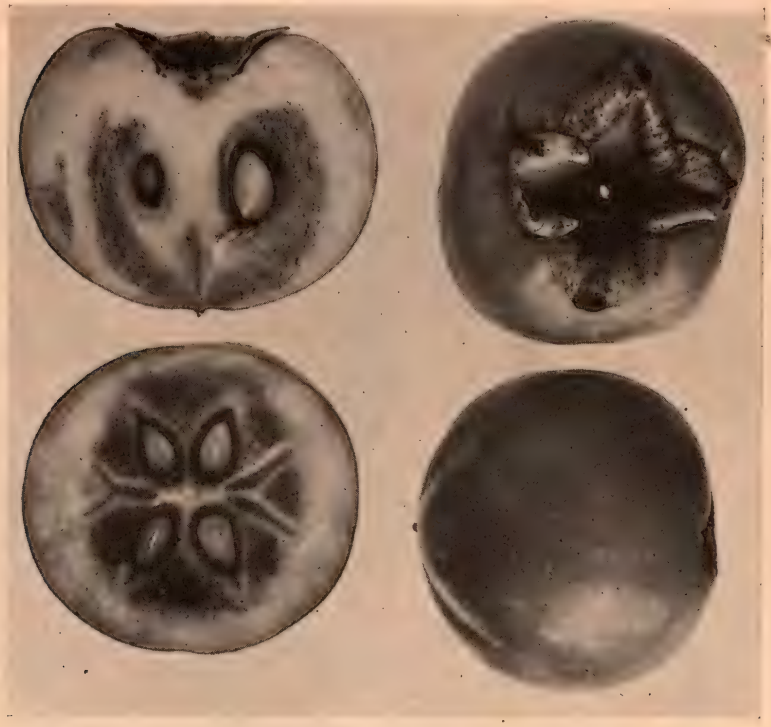

Fig. 147.—Fruit of the Okame variety (two-thirds natural size).

This fruit is highly recommended for planting at the present time in both Florida and California on account of the high quality, good yields and the fact that it is non-astringent when still hard.

Gailey—Fruit roundly-conical, slightly longer than broad, very small. Skin dull red with pebbled surface. Flesh usually very dark and seedy. This variety is not ordinarily recommended for its fruit but is noteworthy for its production of staminate flowers and is used as a source of pollen for those varieties needing cross pollination to produce fruit.

Hachiya—Fruit oblong-conical with roundish apex and short black point; very large, 3-3¼ inches long. Skin glossy, deep orange-red and very attractive, with grayish lines around apex. Flesh deep yellow, firm and frequently of a custard-like consistency, astringent until ripe; practically always seedless in Cali-

fornia but frequently showing one or more seeds in Florida. This fruit is of very high quality and by many is believed to be the best of the varieties in this country. It is the standard commercial variety in California and probably represents 95 percent of the bearing acreage there. It has proven to be a shy bearer in Florida and is not grown to any extent here.

Fig. 148.—Fruit of the variety Tabor's No. 23 (Natural size).

Hyakume—Fruits varying from roundish oblong to roundish oblate, large (up to 3 inches long). Skin buff yellow to orange and frequently netted about the apex. Flesh dark cinnamon, firm, sometimes fibrous but of very pleasing quality. Season October.

Nectar—Fruit oblong, pointed; small, 2½ inches in length. Skin smooth; reddish yellow when ripe. Flesh dark, sweet, fairly firm and nearly always contains seeds.

Okame—Fruit round to oblate with well defined quarter marks; medium to large, average about 2-2¼ inches long by 3 inches across. Skin orange-yellow to carmine when very ripe.

Fig. 149.—Fruit of the Tamopan variety (two-thirds natural size.).

Flesh light yellow with light brown center, tending to transparency as it becomes very ripe; astringent until it starts to ripen; several seeds. Season October.

Ormond—Fruit oblong conical, small to medium, apex beaked with four indistinct radiating lines at right angles. Skin smooth, yellowish red with minute scattering dots and whitish bloom, very tender. Flesh deep orange to red near center, meaty and only moderately juicy, seedy ordinarily but usually with only 2

or 3 seeds and frequently seedless; astringent until soft. Very late November and December. Keeps exceedingly well. First fruited in Volusia County as a graft from a small seedling sent from Washington.

Taber's No. 23—Fruit round to oblate with flat or depressed apex; small. Skin red with dotted effect. Flesh very dark and speckled; sweet but tending to be stringy; seeds numerous, 8 to 10. Season September and October. An excellent home fruit but rather small.

Fig. 150.—Fruiting limbs of the Tamopan with a heavy crop of fruit. The limbs are willow-like and hang downward when carrying fruit.

Tamopan—Fruit oblate and very flat, marked by a deep constriction around the fruit near the stem end, as if two fruits had been pushed together; very large, 3-5 inches across, single specimens sometimes weighing a pound. Skin reddish-orange, thick and tough. Flesh light orange, astringent until ripe, soft and very juicy and sometimes stringy, always seedless. Tree a very vigorous grower and very prolific; very tall and willowy. This variety is used to some extent commercially but opinions

vary as to the quality of the fruit which is quite soft and not very rich. The fruits are said to be non-astringent when green in some localities in China and Japan and from a few localities in California but are always astringent in Florida as far as known.

Fig. 151.—Fruit of the Tanenashi variety.

Among various fruits there is a wide difference apparent in the location of the constricting line about the fruit. Fruits from some trees have this line almost exactly midway between stem and apex while in others the position of the constriction is at varying distances between this and the stem end. The posi-

Fig. 152.—A cluster of almost mature fruits from a Tanenashi tree. Note the bloom partially rubbed from the fruit in carrying.

tion of this constriction is usually the same on fruits from a given tree and it is possible that more than one variety or varietal strain has been introduced under the name Tamopan.

Tanenashi—Fruit roundish conical with slightly pointed apex, very large and symmetrical, 3-3¼ inches long and almost as broad. Skin light yellow and very bright, until almost mature when it changes to a brilliant light red. Flesh yellow, of a peculiar pasty consistency and of very high quality, astringent

until ripe, practically always seedless. Season September and October. This is at present the standard commercial variety in Florida and is grown to some extent commercially in California. The trees are roundish in shape and bear very heavily under Florida conditions.

Fig. 153.—Fruit of the Triumph variety (natural size).

Triumph—Fruit oblate and of pronounced tomato shape; small, not over 2½ inches across. Skin red or reddish-yellow and frequently with grayish cracks around the apex. Flesh yel-

low, firm, of good quality, astringent until ripe; usually with few seeds. Season September to November, a good home fruit.

Tsuru—Fruit long, conical, the longest in proportion to size of any of the varieties, large (2¼ by 3¼ inches). Skin bright orange, reddening as it ripens, rather thick and glossy and with heavy purple bloom when green. Flesh dark yellow, granular,

Fig. 154.—Fruit of the Yemon variety (two-thirds natural size.)

firm, astringent until very ripe and frequently ripening unevenly, with few or no seeds. Ripens very late and is said to be a great favorite in the Orient but not grown extensively in this state.

Yeddo-Ichi—Fruit round oblate, size medium, 2 to 2½ inches in diameter. Skin red to tomato red, somewhat glossy and with many dots and with pencilings around apex. Flesh dark cinnamon when seedy, sweet and tending to be granular; frequently seedless and with light yellow flesh. Season October and November.

Yemon—Fruit oblate and quadrangular with four furrows, medium size with diameter of 2 to 3 inches. Skin orange red to scarlet with heavy grayish bloom. Flesh yellow to red near periphery to cinnamon around seeds; very sweet and soft, seeds none to several. Season late. Quality very good, but too soft for handling and requiring pollination in Florida with consequent dark flesh.

Fig. 155.—Fruit of the Zengi variety (natural size).

Zengi—Fruit round or long oblate. Very small, diameter about 1¼ inches, skin dark orange red, glossy and marked with russeting around apex. Flesh very dark when seedy, almost black, sweet and rich. Season very early but fruit too small for commercial use.

Fig. 156.—Fruit of the variety Tabor's No. 129 (natural size). This variety is not described in the text.

Fig. 157.—Seeds of some of the common varieties of persimmons. (Natural size.)

PROPAGATION AND ROOTSTOCKS

In China and Japan the persimmon is grown as either seedlings or grafted trees. In some sections it has been found grafted on *D. lotus* and some wild forms of *D. kaki.* It was found that it did not make a thrifty growth when grown on its own root in the Southern states and resort was had to the native persimmon, *D. virginiana,* as a rootstock. Subsequently *D. lotus* was tested as a rootstock and found to be very promising in California, though it has not thrived so well in Florida, appearing to be subject to some sort of root rot and highly susceptible to crown gall infection. Practically all of the trees now growing in the southeastern United States are grafted on *D. virginiana,* though this rootstock, while more satisfactory than the other two mentioned, still falls short of being a first class rootstock. It is somewhat hard to transplant due to an extremely long and large taproot with few fibrous roots; does not give long life to the trees worked on it and may tend to dwarf the crop.

In China the *kaki* and *lotus* rootstocks produce large trees of indefinite life but in the Southern states the life of a commercial planting on the *virginiana* stock seldom exceeds 10 years and may be less. There are many individual trees which are much older than this but with the rootstocks used at present the tree must be considered as being comparatively short-lived. The trees come into bearing at an early age, however, usually the second and third year after grafting.

Rootstocks are grown exclusively from seeds. The seeds are gathered from mature fruits and either stratified in sand or dried for planting the following season. Stratification is not necessary to insure good germination. The seeds may be planted directly in the nursery row but by planting in seedbeds and later transplanting from bed to nursery, when the plants are several inches in height, a better lateral root system is developed. The plants should be set about 8 to 12 inches apart in the nursery row with rows spaced 2½ to 3 feet.

The persimmon is highly susceptible to crown gall infection, the organism gaining entrance into the plant tissues through lesions near the surface of the soil. As the graft union is usually made at or near this point it is highly advisable to locate the nursery only on soils known to be free of the disease or on newly cleared land.

Seedlings will have attained sufficient size for grafting at the end of one season's growth; the grafts, inserted then, ordinarily being large enough for permanent planting the next winter. During the period of growth in the nursery row the trees should be kept thoroughly cultivated. Two or three applications of a commercial fertilizer having a relatively high ammonia content should be applied annually to both seedlings and grafted stock.

Grafting is the most satisfactory means of propagation, the work being done during the dormant season, usually in January and February. For small seedling stock, having a caliper of one inch or less, the whip graft is employed, the graft union being made at or near the soil surface. Root grafting is not used. Scions should be of the current season's growth, of a diameter approximating ¼ to ⅜ inch and from 4 to 6 inches in length, having three or four buds left intact. The scion wood should be cut just prior to use, if possible, but may be preserved in good condition for an indefinite period if taken from dormant trees and kept in moist sphagnum moss.

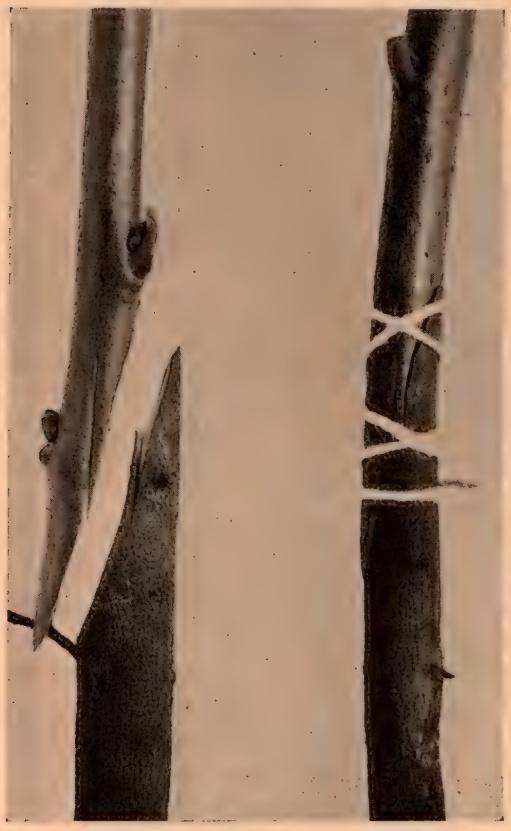

Fig. 158.—Whip grafting. Stock and scion cut ready for fitting on left; fitted and tied on the right.

The whip graft is made by cutting off the stock near the soil surface, the cut being oblique and from ¾ to 1½ inches in length. A "tongue" is made by splitting the stock about ⅓ of the distance from the top of the cut surface. The scion is cut in a like manner and the two

fitted together, using care that cambium of stock and scion are in close contact at least on one side. They are then tied tightly with a few turns of waxed cotton string. The wound may be entirely covered, by pulling soil to the plant, to prevent moisture loss until a union is formed.

Cleft grafting is used on large stocks and in top-working. The stock is cut off squarely, split cleanly through the center with a grafting knife, and two scions, sharpened into long wedges, are fitted into the cleft with the cambium on one side of each in close contact with the cambium of the stock. The scions should be tied in firmly with a strong cord and the wound covered with wax.

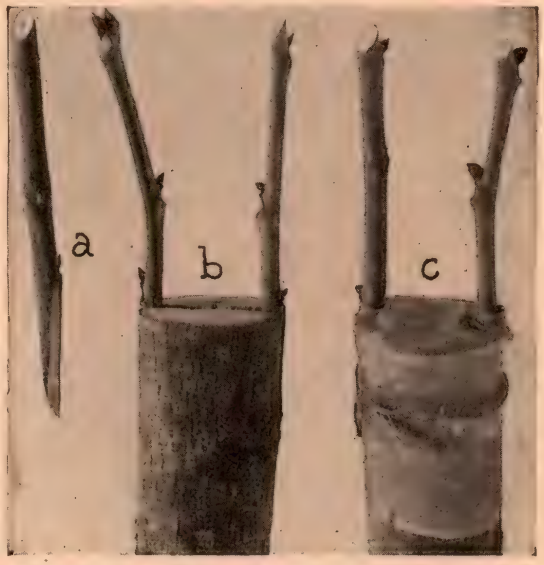

Fig. 159.—Cleft grafting: *a*. scion; *b*. stock split and scions inserted; *c*. scions tied and waxed.

Budding may be employed but usually is not as successful as grafting. In shield budding, a long shield bud is inserted in a T or inverted T incision made in the bark of the stock, the whole being wrapped with waxed cloth. The wrapping is removed as soon as a union is formed, usually 10 days to two weeks after insertion. To prevent the free flow of sap in the wound and its accumulation about the inserted bud, a narrow strip of bark in the form of an inverted V may be removed just above the point where the bud is inserted in the stock. The stock is cut off just above the bud when the latter starts growing. Budding is usually done during the late summer just before bark tightens but may be performed as soon as the bark will slip in early spring.

The practice of top-working old native seedlings in fields is not recommended for commercial production of fruit. Such trees are never spaced with any degree of uniformity which results in a waste of land and of labor if cultivation is practiced.

The working over of these large trees entails considerable labor with no assurance, even if the grafting operation be successful, that the trees will live long enough to repay the involved expense. It would be better to plant young thrifty grafted stock in regular orchard formation than to attempt the doubtful utilization of large volunteer trees.

In handling trees in the nursery it is well to graft rather small seedling trees and transplant them to the field before they become very large. Under these conditions they transplant much better than if they have been left to become large trees. A major portion of the taproot should be left intact in digging, as severe transplanting loss may result from excessive root pruning. Neither should the surface of the roots be allowed to become dry by exposure to sun or wind as the drying of the roots may also occasion considerable transplanting loss.

CULTURE

In this state the persimmon has been found to do best upon the lighter soils which are well drained and which have a good sub-soil, containing some clay, although clay is not absolutely essential. This is perhaps in line with the natural growing habits of the native persimmon which prefers well drained sandy soil. Drainage is evidently more important than the texture of the soil and persimmons should be planted only on those soils which drain freely. A sandy loam with a clay subsoil and good drainage appears to produce the best type of tree.

The trees are transplanted during the winter months—during December, January and February. Early transplanting, prior to January 1, usually is accompanied by better results than late planting, since more opportunity is given for the winter rains to settle the soil about the roots of the trees before the spring dry season sets in.

Spacing distances vary from 15 x 15 feet to 20 x 20 feet, depending somewhat upon the variety planted. Most of the varieties will be found to grow satisfactorily under Florida conditions with a spacing of 15 x 15 to 18 x 18 feet, as they do not make as large trees as they sometimes do under their native conditions in China. On the other hand it is possible in large commercial groves to plant the trees 20 x 20 feet, or even a little wider and interplant when the trees begin to die.

Clean cultivation usually is given throughout the spring months until the beginning of the rainy season. Such cultivation preferably should be shallow to avoid injury to the roots. A cover crop of cowpeas, beggarweed, bush velvet beans, Crotalaria,[12] or other legume planted in the middles as soon as cultivation is stopped will prevent the depletion of organic matter in the soil and thus will help the trees to maintain a vigorous growth.

There is as yet no information from fertilizer experiments available, but a satisfactory growth has been derived from the use of the ordinary commercial fertilizers analyzing 4 to 6 percent ammonia, 8 to 10 percent phosphoric acid and 3 to 6 percent potash. As a general rule 1 pound of fertilizer per year of age of the tree may be applied, i.e., a tree 4 years old would receive 4 pounds. The fertilizer should be spread in a wide band about the tree. The trees are usually fertilized in the spring, about the time they start to leaf out, but it may be advantageous to split the application, applying the second half about the first of July.

Young trees should be headed back to 2½ to 3 feet when planted and the young shoots later thinned to form a strong framework. Five or six shoots should be left spaced over a foot or more of the trunk and so arranged as to avoid bad crotches and to form a well balanced head. Following the formation of a good framework the trees are not usually pruned in Florida except to remove dead, interfering or broken branches. In China, the branches are thinned in such a way as to increase the amount of potential fruiting wood, the fruiting wood of the current year being heavily cut out in the process. This pruning has not been found necessary in Florida, since the Tanenashi and other commercial varieties usually bear heavily and thinning of the fruit rather than an attempt at increasing production may be necessary. With some varieties which grow very rapidly a certain amount of heading back from time to time may be of advantage. The Tamopan, for example, will grow upward very rapidly with a willowy sort of growth which breaks easily under heavy loads of fruit unless it is headed back or the limbs well braced when fruiting.

In plantings of varieties requiring pollination one tree of the Gailey or other variety producing an abundance of staminate

[12] *Crotalaria sericea* has been found to be very satisfactory as a cover crop in many sections of the northern half of the state.

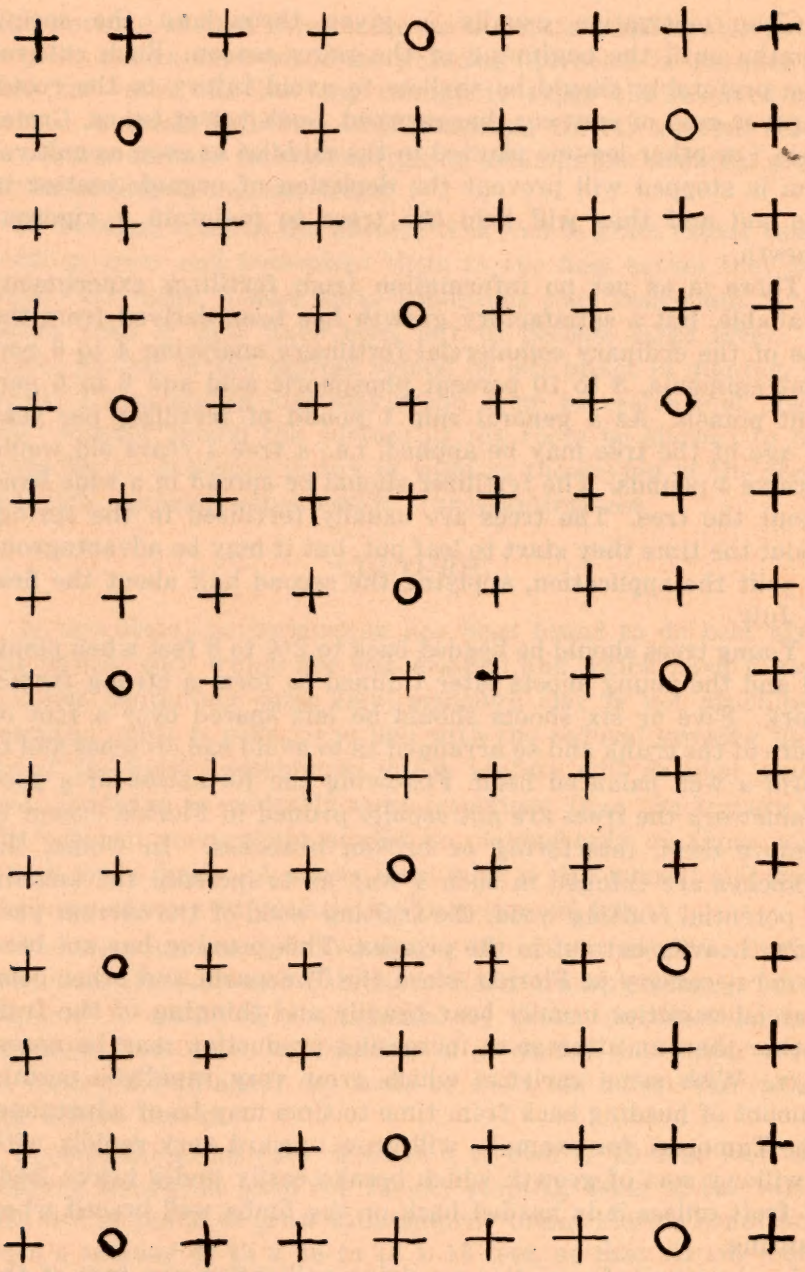

Fig. 160.—Planting plan as proposed by Hume for varieties needing pollination. Circles represent interplanted trees of the Gailey variety.

flowers should be interplanted with every eight trees of the pistillate flowering type. The planting should follow a regular system so as to space the staminate flowering trees regularly throughout the grove. Figure 160 gives the planting system proposed by Hume.

HANDLING THE FRUIT

In Florida the persimmon is shipped fresh, the fruits being picked when they have attained a yellow to reddish color but are still hard. They are clipped from the tree, leaving the calyx and a very short piece of the stem intact on the fruit. Under no circumstances should the fruits be pulled, nor should any be shipped that have lost the calyx. The greatest care should be used at all time to prevent bruising, as bruised fruit quickly decays and will not withstand shipment. The fruits are individually wrapped in paper and packed in baskets in the ordinary 6-basket peach crate, though sometimes the paper wrapping is omitted. The number per basket varies with the size of the fruit. In California the California peach crate is used, in which the fruits are packed in two layers, the packed crate weighing from 18 to 25 pounds; or a single layer crate is sometimes used which is especially adapted to the larger varieties.

The ignorance of the consuming public concerning the stage of ripeness at which persimmons should be consumed is the greatest difficulty encountered in the marketing of this fruit at the present time. Whenever the fruit is placed on the market in large quantities a systematic campaign of education will have to be waged to instruct the public as to when a persimmon should be eaten. Distributors handling the fruit should be fully informed, and in turn advise the consumer, as to the degree of ripeness to be attained before the fruit should be eaten and in addition it would be well to have this information printed on the individual fruit wrappers, so that the consumer will be certain to receive first-hand information. This sort of advertising must wait upon the development of large shipping centers, as no one locality has been able to ship heavily to the northern markets, present plantings being mostly small and more or less widely scattered, thus making impossible a standardization of variety and pack, the economical use of educational wrappers for the fruit, or a general advertising campaign.

The Japanese persimmon is well adapted to climatic and soil conditions obtaining over a large portion of Florida. With right varieties, proper culture, due care in packing, and efficient marketing coupled with judicious advertising there is no valid reason evident as to why this fruit should not become one of the staple horticultural products of the state.

Special Collections
S
49
E2
Department
University of
South Florida